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TWO EPIPARASITIC SPECIES OF *PHORADENDRON* (VISCACEAE) FROM HONDURAS:
ONE NEW AND FOR THE OTHER A RANGE EXTENSION AND HOST DETERMINATION

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ABSTRACT

A new species of *Phoradendron*, ***Ph. mathiasenii***, is described, and a range extension and host are given for *Ph. tikalense*. Both species are from Honduras and grow as epiparasites, i.e., mistletoes parasitizing other mistletoes. The parasitic host for both epiparasitic species of *Phoradendron* is *Psittacanthus angustifolius* (Loranthaceae), which in turn is parasitic on the terrestrial host, *Pinus oocarpa*, a common forest tree in the collection area. Although the two species of *Phoradendron* parasitize the same parasitic host and co-occur in the area, they are distinct morphologically. Many plants of ***Ph. mathiasenii*** were observed at several collection sites in the study area while plants of *Ph. tikalense* were observed at only one site.

Key words: epiparasitism, Loranthaceae, *Phoradendron*, *Pinus* parasites, *Psittacanthus*, Santalales, Viscaceae.

INTRODUCTION

Epiparasitism, also termed hyperparasitism, is a phenomenon wherein one parasite parasitizes another parasite, or as used here, where a mistletoe parasitizes another mistletoe. The phenomenon is widespread in tropical and subtropical regions and occurs occasionally in temperate zones as well (Hawsworth and Wiens 1966). Nickrent et al. (2010) in their revised classification of Santalales recognize five families with aerial branch parasites generally known as mistletoes; i.e., Amphorogynaceae, Loranthaceae, Misodendraceae, Santalaceae, and Viscaceae. Epiparasitic species occur in each mistletoe family, with the possible exception of Misodendraceae. Misodendraceae have wind-dispersed seed, whereas in the other families seed is dispersed by frugivorous birds.

In the New World, epiparasitism is most common in *Phoradendron* Nutt., a large, geographically widespread, primarily tropical genus of mistletoes (Kuijt 2003). If the closely related sympatric genus *Dendrophthora* Eichler with about 120 species (Kuijt 2000) were merged into *Phoradendron*, a change supported by the molecular work of Ashworth (2000), the total number of *Phoradendron* species would exceed 350. In *Phoradendron*, epiparasitism was mentioned first by Trelease (1916) in his monograph of the genus, but new epiparasitic species of *Phoradendron* have been described since then (Wiens and Hawsworth 2002; Kuijt 2003). Epiparasitism in *Phoradendron* is unusual because a number of these species are parasitic only on other members of the same genus (Wiens and Calvin 1987; Wiens and Hawsworth 2002; Calvin and Wilson 2009). Old World epiparasitism, involving other genera, is reported from Asia (Wiens and Calvin 1987; Barlow 1997), Australia (Barlow 1983), and Africa (Visser 1982; Polhill and Wiens 1998).

It is relatively common for mistletoe to grow occasionally on other species of mistletoe (Visser 1982). The literature contains many such reports. Usually, such incidental mistletoe-on-mistletoe unions are viewed as novelties. Incidental infections

typically occur by chance deposition of seed of mistletoe that is normally parasitic on a variety of terrestrial hosts. However, in some cases the epiparasite develops either a facultative or an obligate relationship with its parasitic host. In facultative epiparasitism, the epiparasite infects a limited number of terrestrial hosts, but also commonly occurs on one or more parasitic hosts. In contrast to incidental (chance) epiparasitism there is usually an element of specificity involved in facultative epiparasitism, i.e., the epiparasite has one or a few preferred hosts. Obligate epiparasites grow only on another mistletoe either over a significant portion of their range, as occurs in the Australian viscid, *Notothixos subaureus* Oliver (Barlow 1983), or over their entire range as occurs in *Ph. falcatum* Eichler, a Mexican and Guatemalan species. That epiparasitism has been a pathway to speciation and diversification gives special significance to the phenomenon and to the two epiparasitic species discussed here.

We here report on two epiparasitic mistletoes collected from the same host at the same locality in Honduras. Consultation of Kuijt's (2003) monograph suggested one to be a new species, while the other was tentatively assigned to *Ph. tikalense* Kuijt, though exhibiting a range extension for that species.

NEW SPECIES DESCRIPTION

Phoradendron mathiasenii Wiens & Calvin, sp. nov.—TYPE: Honduras. Francisco-Morazán: 1 km W of Lepaterique at COHDEFOR-AFE station, elevation 1500 m, parasitic exclusively on *Psittacanthus angustifolius* Kuijt (Loranthaceae), 14°03'10"N, 87°28'15"W, 11 Nov 2000, *Mathiasen 00-47* (holotype RSA!, isotypes ASC, EAP, UC!). Known only from the type locality (Fig. 1).

Plantae maturae glabrae, monoeciae, flavovirentes, globosae, 2–4 dm diametro, in *Psittacantho angustifolio* parasiticae; internodia teretia, 30–35 mm longa (prope basin usque ad 100 mm); foliis ellipticis aliquantum falcatis (30–)45(–60) × (5–)10(–15) mm, margine translucido, apice subacuta usque ad teretia; inflorescentiis 15–25 mm longis,

Fig. 1. *Phoradendron mathiasenii*, *Mathiasen 00-47* (holotype RSA).

2–4 in quoque nodo, internodia fecunda 3(4), floribus 6–14 in quoque internodio; floribus staminatis subinde integra pertenuibus (ca. 1 mm) inflorescentia occupantibus, 8–20 floribus in quoque internodio fecundo; fructis orbiculatis, 3–3.5 mm diametro.

Mature plants glabrous, monoecious, yellow-green, forming somewhat globose clusters, 2–4 dm in diameter, parasitic on *Ps. angustifolius*; cataphylls basal on each branch; 2 or 3 youngest internodes compressed and slightly keeled, older internodes terete, 30–35 × 2–4 mm (basal internodes 50–100 mm long); leaves elongate-elliptical, somewhat falcate, ca. 45 (30–60) × ca. 10 (5–15) mm, attenuate into petiole, margins translucent, apex subacute to rounded; inflorescences 2–4 per node, 15–25 mm long, with mostly 3(4) fertile internodes, 6–14 flowers per internode, male flowers occasionally occupying entire—and extremely thin—inflorescences ca. 1 mm wide, with ca. 8–20 flowers per fertile internode; fruit in early- to mid-development (November) 3–3.5 mm in diameter, orbicular (Fig. 1).

The species is named for Robert L. Mathiasen, lifelong student of the New World mistletoes, particularly *Arceuthobium* Bieb. and *Phoradendron*.

Additional specimens examined Honduras. Francisco-Morazán: all from the same general locality as the type and all parasitizing *Ps. angustifolius*, but representing collections from different years: 14°03'13"N, 87°28'19"W, 6 Mar 1999, *Mathiasen 99-13* (RSA, ASC); 14°03'11"N, 87°28'18"W, 19 Oct 1999, *Mathiasen 99-43* (RSA, NY); 14°03'10"N, 87°28'15"W, 3 Mar 2001, *Mathiasen 01-12* (ASC, MEXU); 14°03'10"N, 87°28'15"W, 17 Dec 2001, *Mathiasen 01-38* (MO, UC).

SPECIES RANGE EXTENSION AND HOST DETERMINATION

Specimens identified as *Ph. tikalense* were collected at only a single site 1 km W of Lepaterique at COHDEFOR-AFE station (14°03'11"N, 87°28'22"W), Francisco-Morazán, Honduras, at 1500 m elevation on 6 Mar 2001. Materials from the collection (*Mathiasen 01-13*) are deposited at RSA, ASC, EAP, and UC. All plants at the collection site were growing on the parasitic host, *Ps. angustifolius*, which in turn was parasitic on a common forest tree in the area, *Pinus oocarpa* Schiede ex Schlechtendal. The color and form of the *Ph. tikalense* plants was strikingly different from that of *Ph. mathiasenii*; plants of the new species formed distinctly yellow-green globose clusters, whereas plants of *Ph. tikalense* were erect and dark green in color.

A comparison of the new Honduran specimens to the isotypes of *Ph. tikalense*, *Tún Ortiz #425* (MO, NY), indicated that they closely resembled *Ph. tikalense*, although they differed somewhat from the description in Kuijt (2003). Kuijt describes the leaves as to 18 cm long and 8 cm wide, whereas leaves in our specimens were considerably smaller. Perhaps more importantly, known collections of the species are from Mexico and the Tikal area of Petén, Guatemala, a region of lowland tropical forest. It is unusual that a species from the tropical lowlands would be conspecific with plants from the upland (approx. 1500 m) pine forests of Honduras several hundred km to the southeast. Further research is suggested to determine the diversity present in *Ph. tikalense* across its range. The following description is made based on our study of available material:

Plants percurrent, glabrous, apparently monoecious, dark green, generally erect, 2–3 dm high; cataphylls basal on each branch; youngest internodes compressed, keeled, and twisted 90° between nodes, older internodes terete, mostly 35–40 × 2–

4 mm; leaves usually lanceolate, ca. 60 (45–70) mm × ca. 25 (15–35) mm, some leaves shorter (40–45 mm), becoming lanceolate-ovate, attenuate into the petiole, apex of young leaves acute, becoming rounded with age; inflorescences 2 per node, 20–25 mm long, fertile internodes mostly 4–5, with 6–12 flowers per internode; male flowers seemingly rare on the available material, and appear to occur near the distal portion of the inflorescences; plants not fruiting at time of collection (March) (Fig. 2).

This collection in southeastern Honduras represents a significant range extension for *Ph. tikalense*. It is also the first collection that we are aware of that identifies a host plant for this poorly known species.

DISCUSSION

The new epiparasitic species and *Ph. tikalense* co-occur at the same locality, and both species parasitize *Psittacanthus angustifolius*, which in turn is parasitic on the terrestrial host, *Pinus oocarpa*. When observed in the field, the two species are clearly distinct, *Ph. mathiasenii* forming somewhat globose, distinctly yellow-green clusters, whereas *Ph. tikalense* is a more erect, dark-green plant. The leaves, although somewhat variable in both species, are nevertheless fundamentally distinct. *Phoradendron mathiasenii* has elliptical, smallish leaves (ca. 45 × 10 mm), whereas the leaves of *Ph. tikalense* are lanceolate and larger (ca. 60 × 35 mm). The best characters to distinguish between the new species and *Ph. tikalense* are those of the inflorescences. Inflorescences of *Ph. mathiasenii* usually have only three fertile internodes, whereas those of *Ph. tikalense* have five or more. Also, *Ph. mathiasenii* occasionally has very distinctive, notably thin (ca. 1 mm), apparently all-male flowered inflorescences. Some of the fertile internodes on mostly-female inflorescences of *Ph. mathiasenii* also occasionally produce these thin male flower clusters. The occurrence of heteromorphic inflorescences is not known in *Ph. tikalense*.

Kuijt (2003) lists several species of *Psittacanthus* as hosts for epiparasitic species of *Phoradendron*, including *Ps. cordatus* (Hoffmanns.) G. Don, *Ps. macrantherus* Eichler, *Ps. sonora* (S. Watson) Kuijt, and other unidentified *Psittacanthus* species. We are unaware of previous studies that identify *Ps. angustifolius* as a host for other mistletoes. However, *Ps. angustifolius* has been observed recently as parasitic host to *Ph. falcifer* Kuijt in Chiapas, Mexico, and Honduras (Mathiasen, pers. comm.), in addition to serving as parasitic host to the proposed new species and *Ph. tikalense*. *Phoradendron falcifer* has also been observed parasitizing *Ps. pinicola* Kuijt in Honduras (Mathiasen, pers. comm.).

Neither *Ph. mathiasenii* nor *Ph. tikalense* are likely to be confused with *Ph. falcifer*, even though they share a parasitic host, because they differ by a number of features: (1) *Ph. falcifer* plants are somewhat orange in color, whereas the two new epiparasitic species are either yellowish-green or dark green; (2) *Ph. falcifer* has a pendent growth form, whereas the comparator species have a globose or upright growth pattern; (3) *Ph. falcifer* is dioecious, whereas the new epiparasites are monoecious; (4) the leaves of *Ph. falcifer* are longer and wider than those of *Ph. mathiasenii*; (5) both *Ph. falcifer* and *Ph. tikalense* have lanceolate leaves but those of *Ph. falcifer* taper gradually from their middle to the apex and base, whereas those of *Ph. tikalense* decrease more abruptly; and (6) the

Fig. 2. *Phoradendron tikalense*, Mathiasen 01-13 (RSA).

female inflorescences of *Ph. falcifer* consist of 5–6 fertile internodes, whereas those of ***Ph. mathiasenii*** typically have 3 fertile internodes.

Phoradendron mathiasenii shares some characters with the large and “exceedingly nettlesome” (Kuijt 2003) *Ph. quadrangulare* (Kunth) Griseb. complex, under which Kuijt lists an extensive synonymy. Shared characters include: (1) the location, with ***Ph. mathiasenii*** occurring in the Francisco-Morazán district of Honduras which is within the large range of *Ph. quadrangulare*; (2) both occur on *Psittacanthus* species; and (3) each is monoecious, glabrous, and exhibits basal cataphylls. However, the two species differ in several important characters including: (1) the stems of *Ph. quadrangulare* are persistently

four-angled while those of ***Ph. mathiasenii*** are compressed at first, then becoming terete; (2) the inflorescences of *Ph. quadrangulare* have 3–7 flowers per fertile internode while those of ***Ph. mathiasenii*** have 6–14 flowers; (3) male flowers are infrequent and irregularly distributed in *Ph. quadrangulare*, whereas male flowers of ***Ph. mathiasenii*** may occupy entire, extremely thin inflorescences with 8–20 flowers per fertile internode. These conclusions are based on the description by Kuijt (2003) and the herbarium sheets of *Ashworth* 259 and *Ashworth* 265 (both RSA), *Wiens* 2495 (RSA), and *Templeton* 9395 (RSA) of *Ph. quadrangulare*.

What level of epiparasitism—incidental, facultative, or obligate—should be tentatively assigned to the new species and *Ph.*

tikalense? We consider the primary structural/functional difference between facultative and obligate epiparasites to be the presence of direct phloem-to-phloem connections via sieve elements in obligate but not facultative epiparasites (Calvin and Wilson 2009). Both physiological (Glatzel and Balasubramaniam 1987) and structural (Calvin and Wiens 1987) evidence lend support to this supposition. Both *Ph. mathiasenii* and *Ph. tikalense* were collected only as epiparasites. The large number of collections of the former suggests that, at least in the area around Lepaterique, the species is either a facultative or obligate epiparasite on its parasitic host, *Ps. angustifolius*. In contrast, *Ph. tikalense* is confirmed as an epiparasite from only a few individuals at a single collection site, and more information is needed before its level of epiparasitism can be assigned with any degree of certainty.

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